THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. VII.—No. 153.

## A TAX ON BRAINS.

A GREAT deal has been talked and written of late years on the decadence of English manufactures, and the successful manner in which foreign competition is coping with our trade. Of all nations, the Americans are our greatest rivals in the production of articles for which our markets have long been considered the best. One has only to walk up a London street, or visit an industrial exhibition, to see that America is rapidly taking the lead in all mechanical inventions applied to common life, and especially in those minor contrivances which husband time and save labour in the thousand and one operations of civilised society.

Strikes between master and man, idleness born of former prosperity, and other more universal causes, have been cited to account for this degeneration of our business with the world at large; but there is one which is, we think, more important than any of these, and which has the merit, at least, of being conspicuous and tangible, we mean the monstrous encumbrance on invention and enterprise which takes the form of the British Patent Law. Giant Blunderbore was never so great a curse to the region which he overshadowed with his club, than this blind and cruel statute is to the practical intelligence of our country. This, if anything, is the poisonous Upas tree beneath which our national invention droops and dies.

"An open career to talent," was a motto of the great Napoleon which the Americans, happily free from hereditary burdens, have sedulously kept in view; and in the United States an original thought, whatever it be worth, is free to grow to its full maturity. A patent there costs only twenty-five dollars. In England, on the contrary, it would seem almost a crime to give birth to a new idea. A man is fined twenty shillings here if he knocks down his neighbour; but if he invent a new machine, and own to the offence, he incurs a penalty of twenty-five pounds. If he persists in claiming it for more than three years, he is made to pay fifty more, and if for more than seven, nothing less than £100 will satisfy the ire, or rather the rapacity of the law. It is a strange circumstance that a man in whom nature has implanted the power to benefit his fellowmen, while improving his own condition, should be severely taxed for his efforts to exert it. We do not complain so strongly at these later exactions, although they are shamefully excessive, because if an invention is successful, they are likely to be small compared to the profits accruing from it; but, that a man should have to pay £25 for the possession of his own idea during the first six months, is to our minds a violence both to his welfare and that of the general public. It is not lack of inventive genius on our part that enables American inventors to outstrip us in the race; we are too heavily handicapped compared with them; that is all.

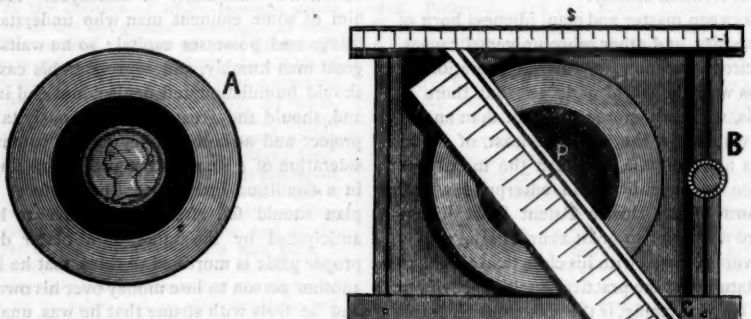
If a poor but intelligent English mechanic has the misfortune to conceive an improvement in some machine brought under his eye (and, as ill-luck will have it, he is just the man to have this fatal gift), his peace of mind is from that moment gone, and his life becomes a source of misery to him. He is naturally anxious to benefit himself and his children by the idea which has occurred to him; but he cannot do this unless he patents it. For that he requires £25, and he does not possess half that sum in the world. Distracted between hope, ambition, fear, and doubt, his tranquillity is destroyed. He bethinks him of some eminent man who understands these things and possesses capital: so he waits upon the great man humbly, and represents his case. Then should humiliation and neglect not end in a rebuff, and, should the great man generously take up his project and advance money for the patent, on consideration of a share in the profits, we find him left in a condition little better than before: for, if his plan should fail after all, or prove to have been anticipated by the same or a better device, his proper pride is mortified to think that he has caused another person to lose money over his own mistake; and he feels with shame that he was unable to pay for and develope his own invention himself. Painful to an independent spirit, and crushing to genius, our present patent law is a degrading incubus to progress, and, in this mechanical age, a disgrace to any civilised country.

No effort must be spared to get rid of the onerous conditions of our present patent system; and we observed with pleasure that an influential deputation, including Sir William Thomson, Dr. Siemens, and Mr. Spottiswoode, recently waited on the Chief Commissioner of Patents on behalf of the new Patent Bill. Much good might also be effected by a Government Commission to enquire into the matter, and bring all the evils of the existing regutions into the light of day: for we are convinced that they have only to be fully known to our legislators to insure an easier and better law. The revenue would suffer little from such a change, for the increased number of patents would probably make up for the reduced charge on each. Not only our trade but our inventors themselves are leaving our shores, and with them departs a portion of our national prosperity and fame.

## ASSAYING BY INDUCTION.

IN describing his new induction balance to the Royal Society (see TELEGRAPHIC JOURNAL for June 1), Prof. Hughes demonstrated its extreme delicacy as a means of assay for metals; and Mr. Chandler Roberts, F.R.S., the chemist to the Mint, has been much employed of late in testing its capacities in this direction as a measurer of the proportions of alloy in coins. In order to assist Mr. Roberts in his determinations, Prof. Hughes has introduced a novel mode of using the balance, which gives the instrument a great range of sensitiveness, and renders it capable of detecting one part of alloy in, at least, ten thousand parts of basic metal, a delicacy which far exceeds any known process of chemical analysis.

This modification of the balance will be readily understood by anyone who has read an account of the latter, by referring to the accompanying figure, where A represents the pair of coils, or induction pan, of the balance on which the coin to be assayed is placed, as shown, and B the other pair of coils, framed round for steadiness, and fitted with a scale for measuring the disturbing effect on the balance of the coin placed in A. Formerly, the disturbing effect of a coin placed in A, was obtained by rapidly transferring the telephone from the secondary circuit of the balance to the secondary circuit of a sonometer, and adjusting the sonometer until it gave a disturbance which to the ear seemed equal in loudness to the disturbance caused by the coin on the balance. The reading of the sonometer was then taken as a measure of the induction value of the coin. An improvement on this method consisted in comparing each coin with a standard placed in the other pan of the balance B, and estimating the *difference* between them by means of the sonometer in the same way. But it is obvious that both of these methods are inferior to one which does not trust to the discriminating capacity of the ear, but which, like the Wheatstone bridge test of resistance, depends upon getting a balance or zero of sound.




THE INDUCTION SCALE.

This balance is got by means of a sliding scale of metal S, which is moved across the top of the measuring pan of the balance B. There are two elements in this scale which determine its power to produce a balance, namely, its width and its thickness. The width of metal appears to balance the intensity of the induction currents produced in the disturbing coin; and the thickness their quantity; but as the intensity is the same for all coins, only the width requires to be varied. The scale is, therefore, made of a uniform width a little over half the diameter of the coils; but it increases in thickness at a regular rate per unit of length, so as to give a mass-gradient. It is composed of zinc, which is a homogeneous, and not readily rusted metal, intermediate in inductive properties between copper above and bismuth below; and for measuring the whole series of metals, the thickness is made to increase at the rate of 1 millimetre in 5 centimetres length. It will be seen, however, that by taking a scale in which the slope of thickness is flatter, say 1 millimetre in 50 centimetres length, a much higher degree of sensibility will be obtained in the balance. Such a scale would be requisite for assays of fine gold-silver alloys.

A straight guide G, is used to fix the direction of the scale as it is slid across the top of the coils in B. But it is found that every differently shaped coin or piece of metal requires a different position of this guide, that is of the path of the scale, in order that the scale may balance the disturbing piece, and a perfect zero of sound be got at all. For example, that path of the scale which enables it to balance a shilling, will not allow it to balance sixpence. For this it is necessary to shift the guide G so that the scale will then slide over a smaller segment of the coils beneath. Indeed, the width of this segment bears a proportion to the diameter of the coin. Only similar coins can thus be directly compared without altering the position of the sliding scale; but it does not take many moments to find by experiment a new position of the guide which gives an absolute zero for another coin; and, once found, this position is always known, since the guide which turns round its end G, is furnished with a fixed scale *s*, which determines its position. It should here be mentioned that the sketch merely shows the first experimental form of the apparatus, and that the finished instrument will have more precise means of measurement. A coin can be assayed by this arrangement in less than a minute. It is simply placed in the pan A, and the scale S is slid to and fro with one hand till no sound is heard in the telephone held to

the ear by the other hand. This zero point can be very correctly found, for a millimetre or two to either side is sufficient to cause a faint sound in the telephone. When the zero is got, the scale is read off at the index P, and the value obtained is an assay of the coin. Tables of the proportion of alloy in coins corresponding to these readings can in this way be prepared for immediate reference, and thus a sure, delicate, rapid, and clean mode of assay is provided. It is worthy of remark, too, that, unlike the chemical balance, there is here no interference from mechanical friction, and the induction balance preserves its sensibility whether the mass experimented upon be comparatively large or minute. To show how wide is its range of efficiency, even with the ordinary scale, we give the readings for equal discs of different metals: gold 163, silver 203, copper 115, aluminium 134, zinc 68, bismuth 24. One of these instruments is, we believe, being made for the Mint.

## ON THE ORIGIN OF SOUNDS IN THE TELEPHONE.

By COUNT DU MONCEL.

THE experiments of MM. Spottiswoode, Warwick, Rosetti, Canestrelli, Saul Roy, Millar, Lloyd, &c., and above all, those of M. Ader, have fully demonstrated that speech can be reproduced by a magnetic core simply enveloped by an electro-magnetic helix; but in most of these experiments the transmitter has been a speaking microphone actuated by a more or less powerful battery. Therefore, it may be said that if so strong a battery is necessary to produce these articulate sounds, the feeble currents from a Bell transmitter would be inadequate to do so. Hence these experiments do not completely demonstrate my explanation of the source of telephonic sounds, and it is necessary that speech should be produced from the feeble Bell telephone currents themselves. The experiments I have made to this end are quite conclusive. For transmitter I took a small ebonite telephone, made by M. Breguet, and for receiver the little apparatus I described to the Academy, on March 17th, 1879. It consists in a fragment of watch spring fixed on a piece of pine plank and enveloped, where it meets the plank, in a small helix of very fine No. 32 wire. This piece of spring, which projected beyond the bobbin by about 2 centimetres, was strongly magnetised, and when the helix was connected in circuit with the telephone, it sufficed to hold the plank against the ear to hear the words spoken to the telephone in a distinct manner. The reproduction was certainly somewhat feeble, and it was necessary to talk as loud as one talks to a phonograph, but the repetition of the words was very distinct; and it was clear that the sounds were not mechanically transmitted, for if both line wires were connected to the same end of the helix, no sound was heard. It is, therefore, certain that induced currents, generated by a Bell telephone, can reproduce speech in a magnetic plate surrounded by a helix, without any diaphragm influenced by that plate. I am more than ever convinced that the speech of an ordinary Bell receiver is only the result of molecular effects in the diaphragm due to magnetisations and demagnetisations caused by variations in the magnetic state of the core. If we hear better with a telephone having a diaphragm, it is because the latter, serving as an armature, exalts *(sur-excite)* the magnetic power of the core, and because it finds itself affected by the vibrations of the telephone case fixed to one of the ends of that core. M. the Abbé de Laborde has also demonstrated this last effect in a very ingenious manner, by showing that a diaphragm, made of any non-magnetic substance whatever, transmits sounds, whatever its position with respect to the magnetic core, provided there is contact between it and the case of the telephone, and he has likewise found that an iron diaphragm at a distance from the core reproduces sounds in the same manner as any other diaphragm in the same position. Only when in the neighbourhood of the core were the sounds reproduced with much greater force, precisely because of the greater energy then communicated to the magnetic system. Nevertheless, it cannot be said that the resultant vibrations of electro-magnetic attractions cannot be produced in a telephone; but it is in this case necessary that the transmitted currents are intense enough to determine these attractions, and it is impossible for me to admit that an electric current, which, according to M. Galileo Ferraris, is no stronger than the current of a Daniell cell in traversing a telegraph line capable of going round the earth 290 times, can have the power to provoke electro-magnetic attractions able to cause the complex vibrations which constitute speech. I believe, therefore, that the theory which I have mooted in my note of March 24th, 1878, is now completely demonstrated.

## AN ELECTRICAL WATER LEVEL INDICATOR.

AMONGST the objects exhibited at the recent *soirée* of the Institute of Civil Engineers, held at South Kensington, the Electrical Water Level Indicator, belonging to the Nottingham Waterworks Company, and designed and constructed in the engineering department of the Postal Telegraphs, excited much interest. The apparatus exhibited consisted of a "Transmitter" and a "Receiver," the latter being in connection with a transmitter fixed at one of the reservoirs of the Company referred to, at Nottingham. During the course of the evening the visitors had thus the opportunity of seeing the actual working of the apparatus, and of observing the changes in the level of the water in the reservoir at Nottingham. Apart from the ingenuity of the invention, the apparatus exhibited was a masterpiece of constructive finish, and did extreme credit to the Postal Telegraph mechanicians. The principal part of the apparatus is the "transmitter," by means of which, on the rising of the float attached to it, a *momentary* contact is made, which causes a positive current to be sent to line at every inch of rise, and a momentary negative current at every inch of fall of the float. The importance of arranging the apparatus to make *momentary* contacts only is evident, otherwise, from the slow rise and fall of the water level, the series of currents would be continued ones which would soon exhaust the battery.

The method by which the object in view is obtained is shown by fig. 1, which represents the arrangement of the "transmitter." *f* is a small metal disc, having a quarter of its circumference faced with a projection of platinum *b*; this projecting piece makes contact, when the disc is turned, with either the spring *d'* or *d''*, the ends of the latter being faced with platinum to insure good contact being made.

The disc *f* is fixed to an axis, to which is also attached the weight W; on the axis is a pinion, into which the wheel A gears.

Behind wheel A is a second wheel A' (shown by the dotted line); this wheel has a pin *p'*, which works in the slot S cut in the front wheel A; the length of this slot is such that if we suppose the pin to be at one end of the slot, and the wheel A' to be held in that position, then a rotatory movement of the wheel A, sufficient to move the other end of the slot up to the pin, will cause the disc *f* and the weight W connected to it to make a complete revolution, that is to say, the weight W will have been turned in the direction of one or other of the arrows according as A is turned in one direction or the other, and when it has made a complete revolution, together with the disc *f*, then the latter will have made contact with both the springs *d'* and *d''* in succession.

Fixed to the face of the disc *f* is a pin *p*. This pin, when the apparatus is in the position shown in the figure, lies between two pawls *t t*, attached to the triangular piece B, which rocks on a centre *a*. The pawls are maintained in the position shown, relative to the piece B, by a small spiral spring *e*, which draws them down against small stop pins fixed on B.

The whole rocking piece can be thrown over against either of the contact screws *g'* or *g''*, and

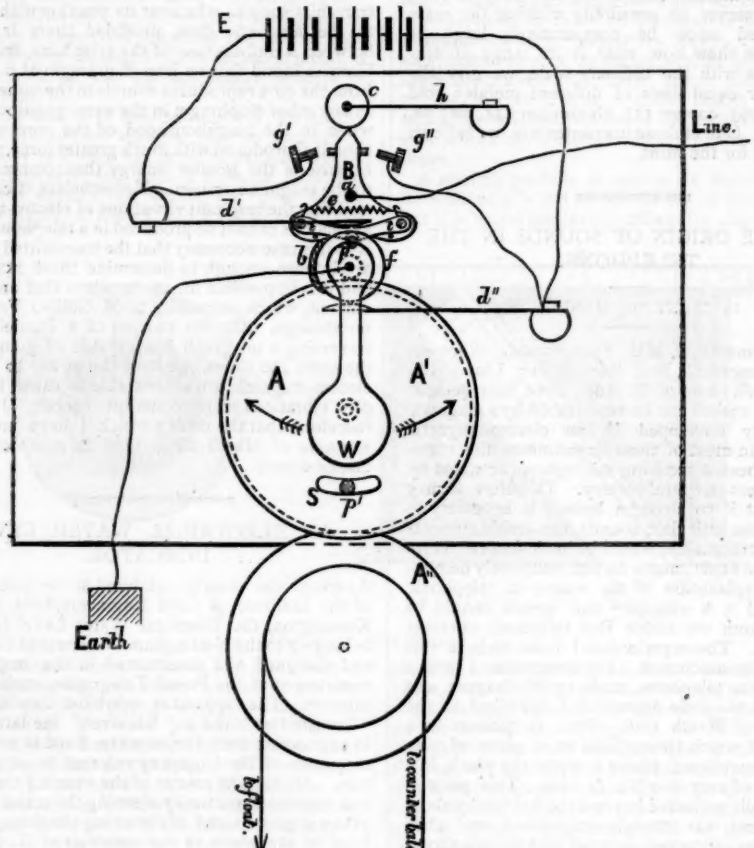



FIG. 1.

when against either of them will be held firmly there by the little wheel *c*, which presses, by means of a spring *h*, against either one side or the other of the pointed top of B.

The wheel A″ which gears into A′ is connected to the float by means of a chain, and the whole arrangement of the gearing is such that an inch rise of the float can turn the disc *f* through a complete revolution.

The electrical connections are those shown, the line being connected to the rocking piece B, which is insulated from the rest of the apparatus.

To understand the working of the arrangement, let us suppose that all the parts of the apparatus stand in the position shown, when the float stands at an exact inch mark. Let us suppose the water commences *rising*; for the first half inch of rise then, the wheel A′ will have been turned so as to bring the pin *p*′ to the left hand end of the slot; as the wheel A′ then continues to rotate it now turns the wheel A and rotates the disc *f*, and also moves the weight W, in the direction of the right hand arrow. The rotation of the disc causes the pin *p* to push against

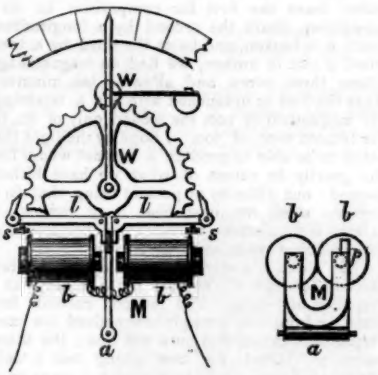



FIG. 2.

the left hand pawl of the rocking piece B, and to move the latter over towards the contact screw *g*″. After a certain angular movement of B has taken place, the action of the spring C carries it completely over to *g*″, and in this position the pin *p* clears the left hand pawl. Supposing, now, the rotation to be continued so that the lever of the weight W is at right angles to the position shown, then the platinum projection *b* will be making contact with the spring *d*″; but this will not cause any current to pass out to line, since in this position both line and earth (which is connected to the frame of the apparatus) are both connected to one pole of the battery, whilst the other pole of the latter is free. On continuing the rotation, however, the weight W arrives at the vertical position, which completes the inch movement of the float, and then topples over to the left making contact in its fall, by means of *b*, with the spring *d*′; at the moment when this takes place zinc is to earth through the spring *d*′ and the projection *b*, and copper is to line through *g*″ and B, consequently a positive current is sent to line. When the weight has completed its descent the whole arrangement resumes the position shown.

The pin *p*, it may be observed, in passing the right hand pawl, when the weight is falling, merely lifts it up and passes under it without affecting the position of B; in fact, as long as the rotation of *f* takes place in the direction just indicated, B will remain over against *g*″.

Inasmuch as *f* is geared, through the medium of the pinion, direct on to A, the quick fall of the weight will cause A to rotate through a corresponding angle: this the slot *s* allows A to do without affecting A′.

If the float falls, all the motions become reversed, viz.: the rocking piece B becomes thrown over to *g*′, and a negative signal is sent when *b* makes contact with *d*′, for then zinc is to line through *g*′, and copper to earth through *d*″.

It will be evident that the whole arrangement is such that a signal cannot possibly be transmitted unless the weight makes a complete revolution, and then it can only be a momentary signal.

The receiving portion of the apparatus does not possess any particularly novel points. It is represented by fig. 2 (drawn to a smaller scale than the transmitter); M is a horse-shoe permanent magnet, fixed on an axis *a*, so that its poles can move backwards and forwards between the poles of two ordinary electro-magnets *b b*, whose wires are joined together in one circuit. A projecting piece *p*, of the horse-shoe magnet, lies between the bent arms of the levers *l l*. These levers rest normally against the stop screws *s s*. When a positive current passes through the electro-magnets, the permanent horse-shoe magnet is moved, say to the left, thereby moving the left-hand lever, the pawl at the end of which moves the toothed wheel W one tooth forward, representing one inch of movement of the float. Similarly a negative current moves the horse-shoe magnet in the reverse direction, thereby actuating the right-hand lever, and moving the wheel in the reverse direction.

The levers *l l* are so arranged that, when in their normal position, the pawls attached to them stand clear of the teeth of the wheel W. The little wheel w at the end of a spring falls between the teeth of the wheel W and keeps it steady.

## THE INDUCTION BALANCE AND SONOMETER.

By PROF. D. E. HUGHES.

(*Continued from page* 183.)

VI. As yet the instrument has given no indications of molecular change produced by magnetism in non-magnetic bodies, but the great change which takes place in all magnetic bodies, except hard-tempered cast steel, indicates that a molecular change of structure, analogous to that of tempering takes place upon iron, steel, and nickel.

If we place a disc of iron in one of the coils, we find that the balance is destroyed, and that the iron has weakened the induction by the absorption of work done in inducing the circular currents. This can be perfectly balanced by placing a small coin or disc of silver or copper in opposite coils; but if an iron wire

or rod is placed perpendicular to the coils, the increase of inductive force takes place in those coils by the conduction of induced magnetism from primary to secondary, and the iron can no longer be balanced by silver, copper, or any non-magnetic metal. The coils must be either removed farther apart, so as to reduce the increased force, or balanced by an equivalent amount of iron or magnetic conduction in opposite coils.

An interesting case of both reduction and increase of force in the same pair of coils occurs if we place a disc of iron, not in the centre of the coils, but in the vacant space between the coils. We thus reduce the force by 150°. If, in addition to this, we place iron wires perpendicular and in the centre, there is increase of force, and if this increase is so proportioned as to be 150°, we immediately restore the balance, and we have here in the same coil two separate pieces of iron, each disturbing the balance and giving out loud tones, but producing no effect whatever, when both are introduced at the same time, complete silence being the result.

VII. These coils prove what has already been long known, viz., that hard steel has a far less conducting power for magnetism than soft iron, although the hard steel has a far higher retaining power. This instrument demonstrates a point, which I have not yet seen remarked, that magnetism does not in itself change the conducting powers, but that it produces a molecular change of structure in iron, analogous to that of tempering; for if we balance two soft iron rods against each other, the balance being made perfect by the addition of fine iron wires on the weakest side, we find that on strongly magnetising this bar, by drawing it across a strong compound magnet, and on replacing it in its coil it has lost 30 per cent. of its conducting power; or if, instead of magnetising, we make this iron red hot and plunge it in cold water, the loss of conducting power will be very similar—25 to 30°. If these experiments are repeated upon various degrees of iron approaching steel in character, we find that as it already possesses hardness or temper, it is less and less affected by magnetism, until we arrive at hard cast steel, where magnetism no longer produces any change in its conducting powers. From this I draw the conclusion that the effect of magnetism is very similar to that of temper, and shall show under the effects of strain and torsion that magnetism produces this temper or strain perpendicular to the lines of magnetic force.

VIII. The instrument shows that a remarkable change takes place in the magnetic conducting power of iron and steel on subjecting the wire under examination to a longitudinal strain; for if we pass an iron wire through the centre of both coils, half a millimetre diameter and 20 centims. or more in length, so arranged by a winding key that we can apply a strain to this wire, we find a magnetic conducting value, unstrained, of 100, but on applying a slight strain its value rapidly increases, being more than double at its breaking point. If during this strain we strike the wire, we hear its musical tone, and no matter how much we may wind or unwind it, provided we do not pass its limits of elasticity and similar wire is used, that the same musical tone will invariably give the same magnetic value. Thus the note A, or 435 complete vibrations per second, gave always the magnetic value of 160, or 60 per cent. increase of power over the unstrained wire. If whilst this wire is strained, giving the value 160, we magnetise it by drawing over it a strong compound magnet, the note remains the same, showing no difference of tension, but its magnetic value has fallen 80°, being now 80 instead of 160; and this wire can never again be brought by strain up to its previous high conducting powers. Now, as we have seen, that magnetism produces no change in hard-tempered steel, but that it does so in soft iron very analogous to that of temper, and as the effect of strain would be also to harden the fibres by bringing them all parallel to the line of mechanical strain; and as this improves its conducting power, while magnetism instantly destroys all the benefits of the longitudinal mechanical strain, we can only draw the conclusion that magnetism produces a strain analogous to temper, but contrary to that of the longitudinal mechanical strain; in other words, that the magnetic strain is produced perpendicularly to its lines of force.

This view is sustained by the effects of torsion; for if, in place of straining the wire, it is twisted, instead of increasing, it rapidly decreases in magnetic conductive value, each turn or twist decreasing its power of conduction in a remarkable constant line of decrease. At 80 turns of this wire there was a decrease of 65 per cent.; at 85 turns the wire broke, and on testing it to see if magnetism had any decreasing effect on it, I found that it produced no change whatever; but this twisted soft iron wire had now remarkable permanent retaining powers of magnetism, being superior to tempered cast steel.

Again, if we take three similar pieces of soft iron wire, leave the first for comparison in its natural condition, strain the second by a longitudinal strain until it is broken, and twist the third by a torsion-key until it also is broken, we find on magnetising equally these three wires, and allowing ten minutes repose, that the first or untouched wire has a retaining power of magnetism of 100, the second only of 80, the third, or twisted wire, of 300. I hope by the light thus given soon to be able to produce a magnet whose force shall be greatly in excess of what we have hitherto possessed; our difficulty at present being that in order to temper steel, we must heat it to redness, and this allows the molecules to rearrange themselves contrary to the object we have in view.

IX. There is a marked difference of the rapidity of action between all metals, silver having an intense rapidity of action. The induced currents from hard steel or from iron strongly magnetised are much more rapid than those from pure soft iron; the tones are at once recognised, the iron giving out a dull, heavy smothered tone, whilst hard steel has tones exceedingly sharp. If we desire to balance iron, we can only balance it by a solid mass equal to the iron to be balanced. No amount of fine wires of iron can balance this mass, as the time of discharge of these wires is much quicker than that of a larger mass of iron. Hard steel, however, can be easily balanced not only by steel but by fine iron wires, and the degree of the fineness of these wires required to produce a balance gives a very fair estimate of the proportionate time of discharge. The rapidity of discharge has no direct relation with its electrical conductivity, for copper is much slower than zinc, and they are both superior to iron.

X. The instrument shows a marked difference in all metals, if subjected to different temperatures. The value is reduced in non-magnetic metals, and this we should expect from the known influence of temperature on the electrical conductivity; but in the case of iron, steel, nickel (as it has already been remarked by many), the contrary takes place, namely, a far higher degree of magnetic conductivity. A bar of soft iron, whose value at the temperature of the room, 20° C., was 160, became on heating it to 200° C., 300, that is to say, its value was nearly doubled. A bar of pure nickel, whose value at 20° was 150, became on heating it to 200°, 320; thus, in the case of nickel, its value for magnetic conductivity was more than doubled, and

at this heat it surpassed the chemically pure iron at the same heat, giving a magnetic value of 320 against 300 for the iron, but at the normal temperature of 20° the iron had more magnetic power of conduction than nickel. Heating nickel by simply plunging it into boiling water increased its force from 150 to 250, plunging this same bar into ordinary cold water reduced its value to 130; thus the mere difference of the normal temperature of the air in the room and water which had been in this room some hours produced 20° of difference. In fact, I found that the radiant heat from the hand would raise the magnetic value several degrees, and thus nickel may be regarded as a magnetic thermometer far more sensitive than the ordinary mercurial Centigrade.

The instrument also measures the electrical resistance of wires or fluids. In order to make it do this, we have only to place the resistance to be measured across the two wires of one conduction coil and on the other known resistance units. In this way we can produce a perfect balance, for it then becomes an induction bridge, the results and modes of testing of which are somewhat similar to Wheatstone's bridge.

It measures also the electrostatic capacity of Leyden jars or condensers, and is sufficiently sensitive to appreciate and measure a surface of tinfoil not larger than four inches square, the condenser being simply placed between the wires of one pair of coils, and the disturbance produced being measured on the sonometer.

I could cite many more interesting experiments in other branches of physical research for which this instrument offers a wide field of observation; but my object this evening is neither to broach new theories nor to correlate at present the results obtained with views already advanced by Ampère and others.

My only desire has been and is to show the wide field of research the instrument opens to physical enquirers. I trust that, in more able hands, it may serve to elucidate many physical phenomena.

## NOË'S THERMO-ELECTRIC PILE.

By ALFRED NIAUDET.

THIS thermo-electric pile is constructed in various forms of which the figure represents the most simple and the smallest.

The elements are in plan placed horizontally and radiate like the spokes of a wheel; the heated junctions lie towards the centre, and the cold junctions towards the outside, as shown in fig. 1.

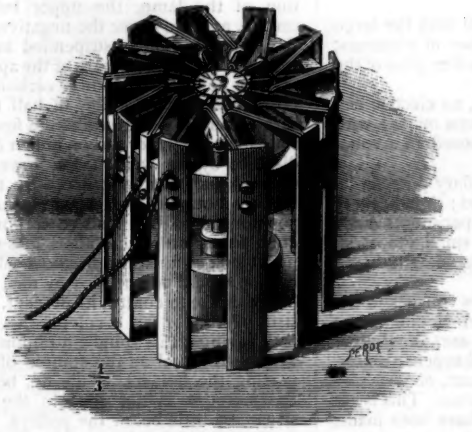


FIG. 1.

The two metals are 1st, German silver, and 2nd, an alloy of antimony, which melts at a temperature a little above the fusible point of antimony; but the exact composition of which has not been made public.

These two metals are soldered together (at least at the hot junction) without the intervention of any other metal; the wires of German silver have fixed at their extremities little capsules of brass which serve as moulds into which the other metal is cast. One of these little capsules is visible in fig 2, which represents a single element of the natural size; it remains attached to the element and forms part of the apparatus.

In the same capsule a little lug of copper penetrates, the extremity of which is equally held in the cast metal, and by means of which the heat is conducted to the hot joint.

The opposite extremities of the lugs of copper are joined and arranged in a little circle and heated by a peculiar flame from a lamp burning methylated spirit, or by a Bunsen burner.

FIG. 2.

In order to concentrate the heat of the flame, the latter is covered by a circular disc of mica, which is held by the copper lugs.

Each cold junction is slightly different: here the fusible metal is soldered to a plate of copper, to which are soldered the German silver wires of the following element.

The plate of copper exposes a large surface, and has for its object the cooling of the junction by radiation in the first place, and by contact with the air in the second.

These plates of copper can be plunged into water at their lower extremities, so that the cooling of the cold junction can be more effectually done; but practically this expedient is not always adopted.

The cooling by the influence of the air is simpler and is practically found to be sufficiently effectual.

These piles have been tested with great care by M. Waltenhofen of Prague; he has compared them with those of M. Markus, and finds them to be very superior to them.

The results of experiments by M. Stephan, show that the thermo-electric elements of Markus have an electro-motive force of one-eighteenth of a volt; but that this maximum corresponds to a temperature very near the fusing point of the metal of which the elements are composed.

Under similar conditions, M. Waltenhofen has found that the elements of Noë, have an electro-motive force of one-ninth to one-tenth of a volt.

Practically, these maximum values must not be expected, and when several elements are connected together, these maxima are never obtained, because all the elements do not become heated to the same degree, and about one-sixteenth of a volt for electro-motive force, and one-fortieth of a Siemens' unit (*) for resistance represents about the power of the pile.

A very useful addition to the apparatus, consists in the addition of a gas regulator for the prevention of the overheating of the pile. This is liable to happen from an increase on the pressure of the gas supply, an increase in the heat being thereby produced, which may fuse the metal of the elements and thus destroy the pile.

The regulator is particularly useful with the large piles, composed of a great number of elements, but can be dispensed with in the smaller piles of the kind illustrated.

With a small pile of 12 elements, an electric bell can be rung and similar experiments made; with 20 elements, water can be decomposed in a voltameter.

With 40 elements, a Planté secondary pile can be charged, or an induction coil worked; in fact, these answer for all the usual physical experiments made with an ordinary battery, and for small industrial operations, such as plating with gold, silver, or nickel, &c.

A great advantage of these piles consists in the fact that they attain their full power in one or two minutes, and the moment they are no longer wanted, the gas can be put out and all expense ceases.

In fine, and this point is important, *the pile does not deteriorate or change from constant use.* This is not the case with those which hitherto have been made, and which, after a time, considerably increase their resistance, so that the strength of the current they give, becomes at last so weak as to render the pile useless.

## SUDRE'S THERMO-PILE.

ONE of the most important of the new French thermo-piles, designed for the electric lighting of large shops, offices, halls, and theatres, is that of M. Jean Marie Sudre, a detailed notice of which we are compelled, from want of space, to defer until our next. It will be remembered that Clammond's pile failed because of the heat source coming in contact with the thermo-electric joints themselves, and gradually consuming them. In Sudre's pile this danger is obviated by interposing a guard material between the heat source and the junctions. The heat source may be steam or hot liquid, heated air or gas circulating in flues past the protected hotter thermo-electric junctions. A large heating surface is offered to the circulating medium. Coke or coal is burned in the pile, which requires no skilled attendance except occasional stoking. Three electric lights, steady and brilliant, can be produced from it, and, as the waste of an intermediate dynamo-electric machine is suppressed, at a cost much less than the cost of gas. Any lamp may be used, but an improved form of Serrin is at present preferred. This thermo-pile is about to be introduced into England by Mr. Applegarth.

(*) Waltenhofen—Dingler's Polytechnisches Journal, 1877. Vol. 22, page 265.

## NEW ELECTRIC LAMPS AT THE ALBERT HALL.

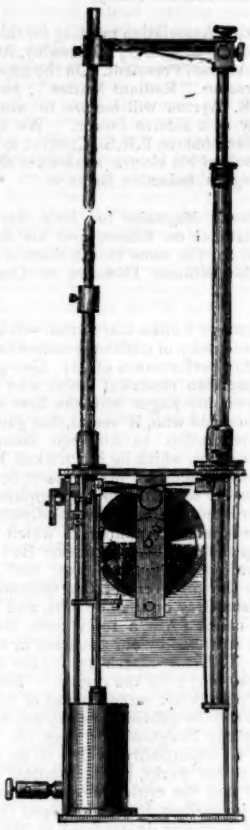
(*Continued from page* 184.)

### KRUPP'S LAMP.

The novelty in this lamp, which is the invention of Baron von Krupp, the celebrated manufacturer of heavy ordnance, consists in the application of an automatic brake, instead of clockwork, to regulate the length of the arc. The figure gives a side elevation of the lamp, the upper being the positive carbon, and the lower the negative. The holder of the upper carbon is suspended by a jointed chain from a pulley in the centre of the apparatus as shewn, and the holder of the lower carbon is similarly supported by a second pulley of half the diameter, but turning on the same axle as the first pulley. When, therefore, the upper carbon holder descends a certain distance by its weight, the lower holder *ascends* through half that distance. By this arrangement the arc between the carbon points keeps a fixed position, since the positive carbon wastes away at double the rate of the other. As the weight of the upper holder must not be too small, for fear that its motion would be impeded by dirt, it is necessary to have a brake to control its descent. This brake consists of a fly or fan revolving in a well of mercury, and having on its spindle a pinion which gears into a toothed wheel on the spindle of the pulleys supporting the holders. This fly, being immersed in the mercury, is not seen in the figure, but it is situated a little below the pulleys. To prevent the fly from revolving backwards when a new carbon is inserted into the lamp, the tooth-wheel is fitted into a small pawl wheel which locks the pulleys.

When the current is put on it passes first through the hollow helix of wire, which is shown at the base of the figure on the left. This helix is encased in iron to exalt its magnetic effect on an axial core, which is free to move up and down in its interior. A brass rod links this core to the other mechanism of the brake, which consists of a disc turning on the axle of the pulleys, and a brake block fixed at the angle of the jointed lever shown. The current pulling down the core is by this means made to press the brake block against the edge of the disc,

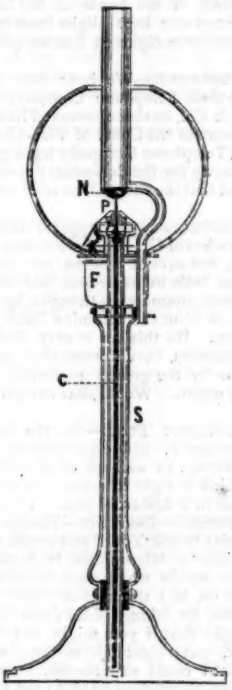
so as to turn it back a few degrees; but as the pulleys are also turned back with the disc, the carbons are thereby separated and the arc established. When the arc widens and the current weakens, the core rises in the helix and slackens the pressure of



the brake block on the disc; the latter, therefore, moves forward, and the carbons approach until the equilibrium is again established. Both the backward and forward ranges of the pulleys are limited by small but ingenious adjustments. This lamp has been introduced by Herr Krupp into his gun factory at Essen.

### HIGGINS'S ELECTRIC LAMP.

This lamp is, as will be seen from the illustration, a modification of Werdermann's original lamp. Instead of raising the lower positive carbon rod against the upper negative electrode by means of cords and counterweights, Mr. Higgins has hit upon the plan of floating it up in mercury. The neatness and convenience of the lamp is thereby increased; but the light itself is not, perhaps, in any way improved. In the figure, S is a brass stand for the lamp, enclosing an iron tube C, filled with mercury, and having at its top an enlarged chamber, also partly filled with mercury. P is the carbon stick floated in the mercury, and guided against the upper carbon N by a tubular guide tipped with copper as shown. A ventilator of radial blades of copper F, surrounds the lower carbon, and as the tube C gets warm, a current of air flows up the interior of the stand S, and escapes between the blades of the vent, thus cooling the lamp. Similarly in the upper




carbon holder a current of air passes inside it from below and escapes above. A globe encloses the whole as shown.

## Notes.

THE ELECTRIC LIGHT.—Werdermann's lamp has been modified by M. Kreiger, Paris, so as to make it operate in any position. The under carbon is pressed against the upper electrode, which consists of a block of compressed magnesia, by means of a spiral spring under its base. Two or more of these carbons may be placed side by side, as in Wilde's candle, and the arc established between their points, against the underside of the magnesia.

THE *Neptune* turret ship, known as the *Independencia*, when in the possession of the Brazilian Government, and now at Portsmouth, is ordered to be fitted with Wilde's electric light.

THE Shah of Persia is stated to have introduced the electric light into his palace at Teheran.

WERDERMANN'S ELECTRIC LAMP.—The engineers of the City of Paris are about to test this lamp for street illuminations. MM. Herz and Noaillon have replaced the upper carbon disc in it by one of copper, so that only one carbon electrode, the positive, is required, a plan first conceived, we believe, by Dr. Siemens. At a recent soirée, in the house of M. Liepmann, Werdermann's lamp was kept alight from 9 p.m. to 2 a.m. by the current from eighteen Bunsen cells.

THE TELEPHONE.—We hear that the impending suit of the Bell Telephone Company *versus* Messrs. M. Jackson & Co., has been removed from the Master of the Rolls Court to the Court of Vice-Chancellor Bacon, and that the Telephone Company have given a bond for £200 as security for the defendants' costs in the action. It is expected that the case will be tried on June 20.

THE AUDIOMETER.—It appears from the audiometric researches of Dr. Richardson that contrary to all expectation, the ears of women are much inferior to those of men both in acuteness and range of hearing. This apparent anomaly is thought by some philosophers to arise from the feminine habit of never listening to reason. Be this as it may, however, the deficiency in question is, unfortunately, more than compensated for by the greater perfection of the female articulating organ. Would that our ears were blunter!

A MICROPHONIC PLOT.—In the interests of the musical profession, and especially of the first and second violinists, as well as of the big drumist, perhaps, we think it right to reveal the following attempt to involve us in a dastardly plot. This letter comes to us from America:—Dear Sir,—Pardon me for writing to you, i write to ask You if you would be Kind enough to tell me how a Microphone is made, or else i will give you the reason why i want to know, and you can experiment on it, i think that i can make a Guitar sound Louder, by taking ideas from the microphone, and i thought that if you might not want to experiment on it, you might tell me how a microphone is made so that i could experiment, i am a poor Young Married man, Struggling hard to get along, and i play the Guitar, and i thought if i could make the Guitar sound louder, it would be one of the main Instruments in a band, it would do away with second and third violins, and would give better satisfaction, and now I ask you either to make that improvement yourself so that I can procure a loud sounding Guitar and introduce it in a Band, and make a living by it, or else you tell me how a microphone is made, so that i can experiment on it, and you will receive your reward. Please answer, i will enclose postage stamp for an answer.

THE *Faraday* is about to embark the first part of the Pouyer-Quartier Atlantic cables at Messrs. Siemens' works, Charlton, and is expected to sail with it before the end of June. It will be laid between Brest and the Scilly Isles.

THE time occupied in transmission of the result of the late Derby by the Direct United States cable from the London office of the Company to the destination of the message in New York, was 59 seconds.

THE Chilian fleet has destroyed the submarine cable off Arica. Telegraphic communication with Autofagasta is also interrupted.

BY the conditions of our treaty with Afghanistan, a line of telegraph will be erected between Cabul and India, *via* the Khurum Valley.

THE British Association meeting for this year will be inaugurated at Sheffield, on Wednesday, August 20th, by Prof. G. J. Allman, President. On the 22nd Mr. Crookes will discourse on "Radiant Matter"; and on the 23rd Prof. W. E. Ayrton will lecture to working men on "Electricity as a Motive Power." We also hear that Mr. Chandler Roberts, F.R.S., Chemist to the Mint, will give the result of his electric analysis of alloys by means of Prof. Hughes' Induction Balance.

IN *Scribner's Magazine* for June there is begun a series of articles on Edison and his inventions. In *Good Words* for the same month there is an interesting article by Sir William Thomson on Compass Adjustment.

MR. PRESCOTT UNDER CRITICISM.—We were recently under the necessity of criticising somewhat severely the latest literary performance of Mr. George B. Prescott, the new American electrical writer who knows so well how to enrich his pages with the best work of European authors, and who, it seems, has gained no inconsiderable reputation in his own country from the skilful manner in which he has tricked himself out in these borrowed plumes. Mr. Prescott does not appear, however, to be so ready to appropriate foreign criticism. Our remarks, which were directed principally against the barefaced manner in which he attempted to cover up the merit of Professor Bell in the invention of the speaking telephone, and of Professor Hughes in the discovery of the microphone in favour of Mr. Elisha Gray on the one part, and Mr. Edison on the other, called forth a reply from that gentleman, which was answered by our reviewer in the same number. [*See* T. J. for March 15 for the criticism itself, and T. J. for May 1 for the review.] Now, it turns out that Mr. Prescott felt rather proud of his reply, for he has caused it to be published *in extenso* in the American *Journal of the Telegraph* for May 16; but with that fine sense of impartiality, which is so conspicuous a feature in all his works, he has omitted both the criticism itself and the critic's answer. For the credit of American journalism, it is to be hoped that this shining instance of fair play is confined to the official organ which Mr. Prescott sways; and we sincerely trust that the spirit of that very famous author will not spread to other institutions of the United States, for example, the Law Courts, for then we should expect to see all the evidence for the plaintiff suppressed and only that of the defence communicated to the ears of the jury. But, indeed, Mr. Prescott is welcome to any triumph he may gain upon such terms.

ELECTRICAL RESEARCH.—Formerly in the days of the supremacy of classical education it was thought that books and lectures could impart all that was necessary for a student to learn; then people began to realise that practical work was equally important, and laboratories grew into existence. But even in the present day the repetition of standard experiments in these laboratories is thought to be the proper work for the learning mind; could not, however, that large amount of care and time that is bestowed, where laboratory training is in favour, on the repetition of some such measurements as those of Regnault, be better employed in advancing existing knowledge; for, although it may

not fall to the lot of every one to discover a telephone or phonograph, it is quite within their power to aid, even if it be in a very small degree, in extending our acquaintance with the laws of nature. Consequently we regard it as a step in the right direction that Dr. Muirhead and Professor Ayrton, at their laboratory, adjoining the Telegraph Works of Messrs. Latimer Clark and Muirhead, intend making one of the most important parts of the education of their pupils the training them to carry out original research in electricity and magnetism. Of course, in addition, the students of telegraphy will be taught the manufacture and testing of electrical apparatus, and the mathematical and experimental theory of electricity as applied to telegraphy. We may expect that the experience which Dr. Muirhead has gained in successfully solving the difficult problem of duplexing with his patent "Inductive Resistances" so many of the long cables in the Indian and Atlantic Oceans and in the Mediterranean and Red Sea, combined with the experimental skill that has enabled Professors Ayrton and Perry to carry out so many electrical and other investigations in Japan, will be of great assistance in the training of Telegraph Engineers who desire, not only to practice satisfactorily their profession, but who in addition aim at advancing it by invention.

MUNIFICENT GIFT.—At a recent meeting of the Iron and Steel Institute, the following letter from Dr. C. W. Siemens was read by the President, Mr. C. Williams:—"It having been recognised by the members of this, as well as other institutions, that it would be desirable to have a building of sufficient capacity to represent the societies cultivating the various branches of applied science, as suggested in my inaugural address to the Iron and Steel Institute in 1877, I move that the committee then appointed to promote that object, and to confer with other societies, be re-appointed, and with a view of giving effect to their efforts I hereby offer to give the sum of £10,000 in aid (loud cheers) of the construction of such a building on a suitable site at Westminster, the work to be carried into effect under the supervision of a joint committee, to be presided over by the president of the Institution of Civil Engineers, or his representative" (renewed cheers). The President proceeded to read a resolution of the council, gratefully accepting Dr. Siemens's munificent offer, and appointing a committee to confer with the Institution of Civil Engineers, Institution of Mechanical Engineers the Institute of Naval Architects, the Society of Telegraph Engineers, and such other bodies as might be suitably included in the project.

MR. DAVID BROOKS' system of underground telegraphs has been purchased by the Western Union Telegraph Company for 230,000 dollars. The patent consists in insulating telegraph wires in cotton, and laying the whole in a wrought iron pipe filled with petroleum. This is done to protect the wires from the moisture of the ground. Experiments have been made with this system by the Pennsylvania Railway Company using it in its block signallings with marked success. The wires, encased in pipes, were laid in trenches beside the track. The purchase by the Western Union is for the patent right for the United States only. Already arrangements have been made for the introduction of the system in New York city. Two thousand conductors are to be laid between now and September next, embracing all of the city east of Broadway. This is the initiatory step toward doing away with the overhead system altogether. When General Stager bought the right to use the system in this country it was particularly stated that he was acting in his individual capacity and not for the Western Union Company, of which he is an officer. Yet no one doubted, nor do they doubt now, that there was a thorough understanding between General Stager and the Western Union. This is proved by the prompt arrangements which have been made to introduce the system in New York, which will do away with the Western Union's overhead wires.

PLOUGHING BY ELECTRICITY.—M. Tresca has succeeded in ploughing a field by electricity near Sermaize, in France. Three Gramme machines were employed; the first making 1,200 turns a minute, was driven by a steam engine of six horse-power. This current drove a second machine 400 metres off, at a speed of 1,120 turns per minute, or a third machine 980 metres distant, with a speed of 980 turns per minute, according as it was shunted. The two last machines, which were portable, propelled two ploughs, which were of the Brabant type, by means of two cables. The available power in the process was estimated at three horse-power, showing a loss of 50 %.

## Correspondence.

[We do not hold ourselves responsible for the opinions of our correspondents.]

*To the Editor of* THE TELEGRAPHIC JOURNAL.

### ADER'S TELEPHONE.

SOME difficulties having been experienced by English experimenters in making Ader's telephone from the description we recently gave of it, we applied to Count du Moncel, who has favoured us with the following remarks:—

"SIR,—The figures which you have published in the TELEGRAPHIC JOURNAL are sufficiently explanatory to render unnecessary any further description of the telephone of M. Ader. The figure in the number of the Journal for April 1st, 1879, is of full size, and exactly like the model which I have tried; the wire of the little bobbin is of No. 32 gauge, ·0000185 millimetres in thickness. The instrument is very simple and works always very well when the transmitter is good and is used with a Leclanché battery of the new form. The best transmitter to employ is that of Edison, but the one represented by fig. 7 may also be employed with success. Your correspondent has also tried the apparatus constructed by M. de Combettes, of 92, Rue de Bondy. M. Carpentin, successor to M. Ruhmkorff, has succeeded in obtaining with this system speech through the frame of a door. It was sufficient in order to do this, to fix in the door-frame an iron wire attached at each end to masses of metal and surrounded by a bobbin of fine wire. On applying the ear to any part of the frame, speech can be heard very clearly.

"The system of M. Ader has been patented and the patent has been bought by the Edison Telephone Company of the Avenue de l'Opera; but this company has not as yet occupied the premises, and it is M. de Combettes who has up to the present constructed the pattern of which you have given a cut in your number for April 1st, 1879. I do not know if by reason of the patent it can provide receivers, but certainly it can transmitters, and this is of the most importance, for with ordinary microphones the results are not always satisfactory. There is, however, still the transmitter of M. Bondet of Paris, with which the apparatus works perfectly.

"Being at this moment unwell, I am unable to give you as full details as I would otherwise have done.

"I pray you to accept the assurance of my most distinguished sentiments,

"M. DU MONCEL."

[Our readers will regret to hear that the eye affliction produced by a too zealous study of electric lights. from which Count du Moncel suffers, is still an impediment to his labours.—ED. T. J.]

THEODOR SCHNEIDER.—We are sorry to say that we have been unable to find out whether any book containing a list of German words suitable for telegraphic code purposes, or a German Code book has yet been published? but we fancy that none has been. Perhaps some one of our subscribers may be able to give the information.

C. H.—Thanks for promised paper. Congratulations.

## Reviews.

*The Student's Text-Book of Electricity.* By HENRY M. NOAD, Ph. D. F.R.S. F.C.S. A new edition, carefully revised, with an introduction and additional chapters by W. H. PREECE, M.I.C.E. London: Crosby, Lockwood & Co. Price 12s. 6d.

DR. NOAD'S Text-Book has earned for itself the reputation of a truly scientific manual for the student of electricity, and we gladly hail this new and amended edition which brings it once more to the front. Mr. Preece, as reviser, with the assistance of Mr. H. R. Kempe and Mr. J. P. Edwards, has added all the practical results of recent invention and research to the admirable theoretical expositions of the author, so that the book is about as complete and advanced as it is possible for any book to be within the limits of a text-book. The illustrations are the sorriest features in it; but this is due rather to the engraver or the printer than to the authors.

*L'eclairage Electrique.* By the Count du MONCEL, Member of the Institute of France. Hachette and Co., Paris and London. Price 2fr. 50c.

COUNT DU MONCEL has followed up his little work on the telephone, microphone, and phonograph, a translation of which has, we observe, been published by C. Kegan, Paul, & Co., London, by another upon the Electric Light. It is, like the former, a contribution to the *Bibliotheque des Merveilles*, and is, therefore, intended for the general public; but it is so fully and well illustrated, that the professional electrician may profit by it. M. du Moncel possesses, in an eminent degree, the French talent for elucidating a theme, and in the present work renders his brilliant but occult subject perfectly clear to all.

*Electric Lighting and its Practical Application; with results from existing examples.* By J. N. SHOOLBRED, B.A., M.I.C.E. London: Hardwicke and Bogue. Price 5s.

To electricians wishing in a short time to make themselves acquainted with the history and present development of electric lighting, we would recommend this little treatise of Mr. Shoolbred. It is a professional book rather than a popular one; but anyone knowing the rudiments of electricity can clearly follow it throughout. The chapters on Motive Power and Luminous Intensity are especially valuable and novel; the various photometers employed being fully explained and illustrated in the latter.

*The Electric Light in its Practical Application.* By PAGET HIGGS, LL.D., D.Sc. London: E. & F. N. Spon. Price 9s.

DR. HIGGS is well qualified to produce a book on the subject of the Electric Light, and since his translation of Fontaine's work is out of print, we gladly hail this original treatise of his which embodies much of the latter and adds to it the best of the later forms of electric lamps and machines. The first chapter deals with the voltaic arc and incandescence; the various lamps and machines are then described, followed by a full consideration of the mechanical efficiency of these machines, with sufficient mathematical data to enable the reader to judge of the merits of the machines. The question of cost is next discussed, and the applications of the light, both odd and common are clearly described. Final chapters are devoted to current regulators, and to the manufacture of carbons. Dr. Higgs has been at considerable pains to do his work well, and has carried the history of electric lights further back than any other writer except Colonel Bolton. For example, he illustrates Straite and Edwards two-carbon lamp (p. 9). He, however, unfortunately omits De Moleyn's incandescent lamp, and gives King's as the first. The Messrs. Spon have made a handsome volume of the book.

## New Patents—1879.

1622. "Means employed for producing the electric light." R. C. THOMPSON. Dated April 24.

1635. "Electric light apparatus." J. MACKENZIE. Dated April 25.

1652. "Improvements in and relating to printing telegraph apparatus." W. R. LAKE (communicated by C. Hayet). Dated April 26.

1688. "Portable magnetic appliances in conjunction with medicinal substances for the cure of diseases." T. WELTON. Dated April 28.

1692. "An improved mode of regulating electric currents." J. S. LELLON and H. EDMUNDS. Dated April 30.

1766. "Improved method of demagnetising iron ships." H. HOPKINS. Dated May 5.

1791. "Electric lamps." J. S. LELLON and H. EDMUNDS. Dated May 6.

1949. "Improved apparatus for generating electric currents." J. S. LELLON, H. EDMUNDS. Dated May 15.

2000. "Electric lamps." J. COUGNET. Dated May 20.

2011. "Improvements in electro-magnetic puncturing or stencil pens, and printing apparatus or stencilled plates or paper (complete)." J. M. JOSIAS. Dated May 20.

2019. "Improvements in the apparatus employed in traction, and in other apparatus employed in mines, agriculture, and navigation, by the application to these apparatus of the required motive power transmitted by means of an electric current." J. CHRETIEN and C. FELIX. Dated May 21.

2060. "Apparatus for electric lighting." A. F. BLANDY. Dated May 23.

2110. "Improved means and apparatus for producing light and heat by electricity. C. W. SIEMENS. Dated May 27.

2111. "Electric lighting apparatus." W. R. LAKE (communicated by J. Puvilland and T. Raphael). Dated May 27.

2199. "Lighting by electricity." J. FURSTENHAGEN (communicated by L. Siemens). Dated June 3.

2211. "Telephones." H. C. DOUMONTIER. Dated June 4.

## ABSTRACTS OF PUBLISHED SPECIFICATIONS—1878.

3603. "Flexible electric conductors and tips therefor." G. J. STANFORD. Dated September 12. 6d. This consists in forming flexible conducting cords which will not strain the wires.

3647. "Transmitters for telephones." H. HUNNINGS. Dated September 16. 6d. This describes an Edison carbon transmitter, formed of two metal plates containing a layer of powdered carbon between.

3656. "Manufacture of electrodes for electric lighting." A. H. P. STUART-WORTLEY. Dated September 17. 4d. This consists in covering carbon electrodes with a hood of asbestos (silicate of magnesia) or other refracting substance; and of mixing asbestos or other heat-resisting materials with the carbon, to form the electrodes. The electric arc is caused to take up a position in front of the carbon points by means of a deflecting magnet.

# Proceedings of Societies.

## PHYSICAL SOCIETY.—MAY 10TH, 1879.

Prof. W. G. ADAMS in the Chair.

New Member—Mr. J. KESTRELL EVANS.

DR. WOLLASTON explained the construction of Gower's improved form of Bell's speaking telephone. *See* TELEGRAPHIC JOURNAL for March 1st, 1879.

Prof. W. F. BARRETT then gave an account of some attempts which he had made to overcome the induction clamour on telephones, caused by the ordinary telegraph currents on neighbouring wires. He had tried recently the Bell telephone on a line from Dublin to Armagh, 95 miles long, but the induction noises completely stifled the speaking, whereas the Edison transmitter gave good results. The clamour could be got rid of either by neutralising the induction currents, or by eliminating the noises from the speech. He had taken the second line of experiment. Since the vocal currents differ from the induction ones in potential and period, he attempted to make the latter discharge across from the line to earth by fine needle points, and from a heated spiral of wire in a vacuum, leaving the vocal currents to pass on to the receiver, but without success. Also, since the vocal currents are alternately positive and negative, whereas the induction ones are of one sign, he tried to avail himself of the difference in discharging power of positive and negative currents, but without success. He then tried to take advantage of the difference of period or duration of the currents, the induction currents being longer. He therefore tried to break up the induction currents by interposing a rapidly revolving current interrupter, and to make the sections of the musical note obtained *interfere* with each other by means of an acoustic interference tube, but practically failed in this also. He mentioned these facts for the benefit of others who might be going over the same ground.

Mr. WILSON then read a paper on the Divisibility of Electric Light by Incandescence. By Joule's law, the amount of heat developed in a circuit of resistance R by the passage of a current $C = C^2 R$. Where R is the resistance of generator and connectors $r$, added to the resistance of the light emitter or incandescent wire P.

Therefore since by Ohms law $C = \frac{E}{R}$, we have

$$C^2 = \frac{E^2}{(r + P)^2} \text{ and } C^2 P = \frac{E^2 P}{(r + P)^2}.$$

From this equation the value of P may be also determined. $C^2 P$ is the amount of heat developed in the incandescent wire. We see from it that the smaller the mass of the wire the higher the temperature generated in it, therefore the mass of the wire should be diminished until the fusing point of the metal is almost attained. The question of divisibility resolves itself into our being able to divide a single incandescent source into a number of smaller ones, giving the same total illumination. The author concludes that this can be done by arranging the subdivided sources in "multiple arc" or parallel circuits, provided the total mass, length, and sectional area of the united sources be the same as in the original single source. The objection that increased radiation from the various sources would diminish the first total of light and heat can be met by making the smaller wires still smaller than is theoretically required so as to generate more heat. The author regards the "voltaic arc" as probably falling under the same law: the mass however being smaller in this case.

Dr. COFFIN then exhibited a Trouvé Polyscope, which consists of a small hand incandescent platinum wire electric light, designed for illuminating the more inaccessible cavities of the body in surgical examinations. The current is supplied by a Planté secondary battery, and the light is half enclosed in a small silver reflector, fitted with a convenient handle. The apparatus is portable. Dr. Coffin found that it was open to several objections which he has remedied. Firstly, the heat generated made the lamp so hot that it could not be held to the body for more than a very short time. He overcame this by making the reflector of double silver plates, and circulating water between by means of india-rubber pipes and a bulb, which can be worked by the patient himself, thus serving to distract his attention from the operation. Secondly, the secondary battery exhausts itself in twenty minutes, and the light therefore goes out, while from 12 to 24 hours are required to recharge it. Dr. Coffin has superseded it by a Leclanché battery of eight elements, made by Messrs. Coxetter & Sons, in which the carbon pole is replaced by a copper plate faced with platinum, and no porous diaphragm is employed. This gives a constant light for hours.

## SOCIETY OF TELEGRAPH ENGINEERS.

AT the ordinary general meeting of the Society of Telegraph Engineers, held on May 14, MAJOR BATEMAN-CHAMPAIN in the chair, a paper was read by LIEUT.-COL. FRANK BOLTON, Hon. Sec. of the Society.

Colonel BOLTON, after expressing his debt to Professor W. E. Ayrton for the great assistance rendered by him in the preparation of the paper, stated that his object had been to do a service to electrical inventors by giving them an intelligent summary of the ideas and plans already patented in England on the subject of Electric Lighting. The paper was divided very skilfully into a great many heads, treating of different types of machines and lamps. There are so many of these that we cannot do more than give a few of the most remarkable results brought to light by Col. Bolton's researches into the forgotten archieves of the Patent Office. The paper itself, will, however, appear soon as a pamphlet.

The earliest mention of the accumulation principle in magneto-electric machines seems to have been made in Jauffs patent in 1854. In 1857, Dr. Werner Siemens described the dynamo-electric principle to a German Scientific Society.

In 1866, Messrs. Cornelius and S. A. Varley, patented a plan for producing alternating magneto-electric currents by a vibrating tuning fork, as recently

patented by Edison. The currents of Varley were, however, to be used for telegraphic purposes.

The first patent of the Wilde type of machine having a disc of bobbins parallel to the axis of rotation was due to King in 1846. The Lontin type having revolving bobbins radial to the axis, was first indicated by Allan's 1852 patent.

An incandescent electric lamp was first patented by De Moleyns in 1841, and in 1848, a platino-iridium wire, enclosed in glass, was also protected.

The first patent for "flowing electrodes" of mercury was taken out in 1853 by Binks; and the first for flexible electrodes by Scott, in 1878. In 1853, Binks also patented a vibratory electrode caused to approach and recede from a fixed electrode as in the plan recently devised by Professors Houston and Thomson. Disc electrodes were first patented in 1845 by Wright; multiple electrodes in 1846, by Greener; non-conductors associated with the carbons in 1849, by Pearce; and carbon candles in 1864, by Werdermann, to produce flame for melting rock in boring, as in Jamin's candle, described in our issue for April 15. Lamps regulated by clockwork were first patented by Staite in 1846; those having a fixed length of arc, as in the Wallace-Farmer, by Roberts in 1852; those regulating in one direction (as the Dubosq), by Jackson in 1852; those regulating either up or down (as the Foucault), by Staite in 1847.

In 1853 also, Staite floated up one electrode in a fluid; a plan which Mr. Higgins and M. Ducretet have also devised. In the same year Binks patented a process for impregnating carbons with metals and other bodies to produce a white light.

---

## PHYSICAL SOCIETY.—MAY 24th.

### Prof. W. G. ADAMS in the Chair.

New members: Mr. SEDLEY TAYLOR, M.A., and Mr. WALTER EMMOTT, A.S.T.E.

Mr. W. J. WILSON exhibited a new harmonograph and figures drawn by it. The figures drawn by prior harmonographs are all more or less imperfect, owing to loss of motion in the pendulums actuating the marking pen; and Mr. Wilson therefore designed a new harmonograph, which not only gives perfect figures but admits of the phase of either of the two compounded motions being decreased by a known amount. In this instrument toothed wheels take the place of pendulums, the ratio of the teeth giving the ratio of the periods of the motions. By employing the device of an intermediate wheel gearing with two others and arranging two or more wheels on the intermediate axle, a great variety of phase can be obtained for each motion. An ingenious adjustment by means of a movable nut allows the phase of either or both motions to be altered to a known extent, and then an endless variety of figures can be obtained. As in other harmonographs, a writing table on which the paper is placed and an aniline glass pen are used. Several of the figures, done also on glass, were thrown on the screen, the stereoscopic effect being very apparent. In reply to a query Mr. Wilson said that he had adapted some of the figures to the stereoscope.

Prof. HUGHES explained his new induction balance, and showed some of its principal effects. It is well known that on starting an electric current along a wire adjacent to another wire an induced current is set up in the second wire in an opposite direction to the first or primary current. In the induction balance two primary circuits or coils are taken, with the same current (interrupted by a microphone acted upon by the ticking of a clock) running through both, and between these is placed a secondary circuit or coil in connection with a telephone. The primary coils are so wound as to oppose each other's induction on the intermediate secondary. There is a point, moreover, between them where these opposed inductive influences exactly neutralise each other. If the secondary coil be placed there no induced ticking of the clock can be heard; but if the secondary be displaced to one or other side of this point the ticking can be heard in the telephone, increasing in loudness as the secondary approaches one or other of the primaries. If the distance between the primaries be graduated into a scale this contrivance becomes a sonometer, since it gives an absolute zero of sound with degrees of loudness. It is well adapted for measuring the hearing power of the ear.

By splitting the secondary coil into two parts, and placing each close to its proper primary, so that there are four coils in all, arranged in two pairs, the extremes in one primary circuit, and the means in one secondary, the two opposing parts of the balance can be separated from each other, so as not to disturb each other's action, and the balance made very sensitive by the closeness of the primaries and secondaries. Professor Hughes finds that there is a line or zone of maximum induction midway between each primary and its secondary. If a conductor, such as a piece of metal be put in this position, it has a maximum disturbing effect on the balance, due probably to the electric currents generated in it by the induction. The effect is apparently proportional to the conductivity of the metal. It requires an exactly similar piece of metal put between the other pair of coils to restore the equilibrium of the balance. A difference of alloy or of weight between two like coins is at once observed from the imperfect restitution of the balance; base coins are thus also at once detected. Again, it is possible for a person to tell what particular coin or coins are in one part of the balance by trial of the same coins in his part. When plates of non-magnetic metals are held vertical in the balance their disturbing effect is nil; iron on the other hand gives its maximum effect in this position, because its magnetic effect overbalances its electrical effect. Two pieces of iron may therefore neutralise each other as cores in an induction coil. Hard steel is easy to balance compared with soft iron. Zinc disturbs most when placed along the sides of each pair of coils, iron when in centre. A certain length of metal laid along the outsides of the coils produces silence. The maximum line of inductive force is midway between the coils, and there is a line of minimum force at half the thickness of each coil. A metal placed at these lines of minimum force has no disturbing effect on the balance. Pressure applied to small shot, or spongy gold alters the balance.

Prof. W. G. ADAMS believed that one result of Prof. Hughes' experiments will be the determination of the way in which the law of electro-dynamic induction depends on density. He also imagined that the metal when in the maximum line between the coils gathered the lines of force to itself, whereas when on the minimum lines it could not thus divert them.

Prof. AYRTON cited the early experiment of Faraday with a sheet of copper oscillating, to rest between two opposite magnetic poles. The copper took a long time to stop; but a sheet of iron placed between two like poles was soon stopped, owing to its becoming imbued with an opposite polarity, and deflecting the lines of force. He also suggested that the divergence of the results for conductivity of metals got by the induction balance from those got by the Wheatstone balance, might be due to that electric inertia suspected by Sir William Thomson.

Professor GUTHRIE thought that the induction balance pointed to the conclusion that the disturbing effect of a conducting mass applied in this way is proportional

to the quantity of electricity generated in it under certain conditions of temperature, &c. The determination of the conductivity of liquids would be a useful application of the balance. Henceforth the ear would be used in research as well as the eye.

Mr. CHANDLER ROBERTS gave some results which he had obtained from an examination of certain alloys by means of the induction balance. He had been able to detect a difference in alloy between two shillings of one part in 1,000, and since the law allows a difference of four parts in 1,000, it is probable that considerable saving to the Mint may result from its use. Mathiessen divided alloys into three classes: 1, Solidified solutions of one metal in another; 2, Solidified solution of one metal in allotropic modification of another metal; 3, Solidified solutions of allotropic modification of both metals. For the first class the curve of electric conductivity is a straight line; for the second, a parabolic curve; for the third, a bent line. Mr. Roberts found that the balance gave the characteristic curve for the first class with an alloy of lead and tin, and for the second with an alloy of gold and silver. With a copper-tin alloy, which is a good example of the third class, he found the curve given by the balance to be intermediate between Alfred Risch's curve of density and Mathiessen's curve of conductivity, and judges that the balance is influenced by density as well as conductivity of the metal interposed.

Professor HUGHES said that as the working of metals appeared to affect their conductivity, he was inclined to rely more on the conductivity measurement of the balance than on those of the Wheatstone bridge. In the balance plain pieces of metal were taken, whereas in the bridge wires were mostly taken. He would rather not give any theory yet as to the results obtained from the balance.

## General Science.

### ENGINES FOR WORKING ELECTRIC LIGHT MACHINES.

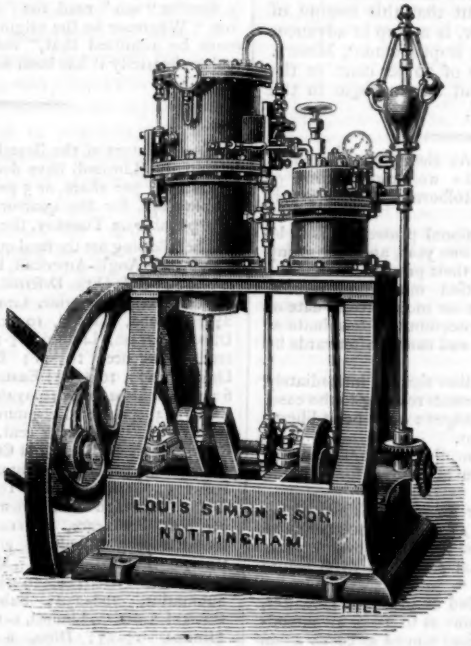
VI.

*Simon and Son's Gas Engine.*

THIS engine has two cylinders, one for driving and the other, of smaller dimensions, for drawing in the combustible mixture of gas and air, and for transmitting it into the driving cylinder. This gaseous mixture passes into the cylinder through a network of metal gauze, and is ignited on the driving cylinder side of it; the result of this arrangement is that the expansive union of the gaseous mixture, which drives the piston, takes place gradually, as the mixture is forced through the gauze, and on the principle of the safety lamp, the combustion cannot be communicated to the opposite side of the gauze, which would have the effect of causing the combustion before it is required.

The valves and governor, which regulate the admission of the gas and the exit of the products of the combustion, are very simple and effective.

Although the expansive effect of the combustion




of the gas and air is a motive power employed in working the engine, it is not the only motive power, and in this point the engine differs materially from others. Each cylinder is water-jacketed, and between the cylinders and the jackets water flows continuously, the source being derived from a bucket or other small receptacle, whence it is pumped by the engine itself. These water-cavities

are in communication with each other. Now the expansion and combustion of the gaseous mixture necessarily generates heat, and this is communicated to the water surrounding the cylinders, moreover, the spent gases are also very hot, and these being caused to pass through a vessel containing a network of tubes through which the water circulates adds additional heat to the water, so much so that the latter very soon begins to boil and generate steam; this steam is allowed to pass into the driving cylinder, and adds greatly to the motive power. When spent it passes out with the spent gases, adding what heat remains in it to the incoming steam, so that a uniform supply of the latter is maintained. The advantages of this type of engine are numerous. First, no water-vessel to cut the cylinder is required; indeed, the hotter the cylinder the better the engine works. However, the greater part of the heat is utilised in generating steam. Next the utilisation of the steam overcomes another difficulty. The dryness of mere gas explosions is destructive to cylinders, and soon destroys the lubrication which has constantly to be renewed. In Simon's engine no such difficulty occurs, as the steam preserves the lubricating agent intact. Also the pressure of the expanded gas does not exceed 40 lbs., which puts but very little racking strain on the machinery.

There can be no doubt but that this engine, of which we give a general view, is a step in advance. We learn that by a recent improvement, Messrs. Simon have obtained a gain of 20 per cent. in the power of their engine without any increase in the consumption of the gas used.

---

THE NEW PATENTS BILL—As clearly formulated by Mr. W. P. Thompson, of the well-known firm of solicitors of patents, High Holborn, the chief provisions of this bill are:—

1st. The duration of provisional protection is to be extended from six months to one year, and the stamp duties thereon lowered to half their present amount.

2nd. A complete specification must, however, be filed before the expiration of nine months from date of original application, or the protection will terminate at the end of the twelve months, and cannot afterwards be renewed.

3rd. The complete specification shall be immediately published, with all other documents relating to the case, and for a prescribed period anyone shall be at liberty to oppose the grant of a patent.

4th. If there be no opposition, the applicant may give notice to proceed, and secure his patent for half the stamp duties now levied.

5th. A patent shall last for 21 years, instead of 14, but shall become void if the £50 and £100 stamps be not duly paid at the end of the third and seventh years respectively, and an additional stamp of £100 before the end of the twelfth year.

6th. Patents can be amended or added to hereafter, but with such fees and limitations as to make an amendment (especially if an addition) almost as costly as an original patent. The amendment, however, then becoming part of the original patent, is not subject to additional stamp duties. (This, however, is still a great improvement over existing practice, and all alterations mentioned so far are in favour of the patentee.)

7th. The Crown shall have power to use any patented invention, paying the inventor such royalty as the Treasury shall consider fair.

8th. If an inventor do not work his invention in the country within three years of grant, and if he refuses to grant licences on such terms as the Lord Chancellor shall consider reasonable, the patent will be annulled.

9th. Inventions, first patented (or imported from) abroad, can in future be patented in England by the foreign patentee (he being the true and first inventor) within six months of the date of the foreign patent, *or of the date of this Act;* but such patents will fall with the expiration of any foreign patent for the same invention, whether granted before or after date of such patent.

10th. The Lord Chancellor shall have power in certain cases to allow a patentee who has accidentally omitted to pay his tax in time, to pay it within three months after it became due, and thereby save his patent.

11th. All patents applied for before the passing of the Act, to be independent of all its provisions, except article 10.

12th. The modes of procedure are altered in many respects, interesting only to patent agents and lawyers.

This bill is decidedly a step in the right direction, though it has faults that will probably be rectified in committee; and it is earnestly to be hoped that it will not share the fate of its less promising predecessors, introduced by the present Government in previous sessions.

---

ERRATA.—In the letter of M. Gaston Planté on page 187 of our last number, col. 1, line 11, and col. 2, line 5, for the "sun" read the "earth." In col. 1, line 13, for "Whatever be the origin of this polar electricity it must be admitted that," read, "With respect to this polar electricity it has been admitted that."

---

The directors of the Brazilian Submarine Telegraph Company (Limited) have declared an interim dividend of 2s. 6d. per share, or 5 per cent. per annum, free of income tax, for the quarter ended 31st March, 1879, and payable on Tuesday, the 24th inst.

The following are the final quotations of telegraphs for the 12th inst.:—Anglo-American, Limited, 55½-55¾; Ditto, Preferred, 84½-85½; Ditto, Deferred, 27-27½; Black Sea, Limited, —; Brazilian Submarine, Limited, 6¾-7¼; Cuba, Limited, 8½-8¾; Cuba, Limited, 10 per cent. Preference, 16-17½; Direct Spanish, Limited, 1¾-2¼; Direct Spanish, 10 per cent. Preference, 10½-11; Direct United States Cable, Limited, 1877, 10½-10⅝; Eastern, Limited, 7⅞-7⅞; Eastern, 6 per cent. Debentures repayable October, 1883, 105-108; Eastern 5 per cent. Debentures repayable August, 1878, 101-103; Eastern, 6 per cent. Preference, 11¾-12; Eastern Extension, Australasian and China Limited, 7⅛-7⅜; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 108-111; German Union Telegraph and Trust, 7¾-8¼; Globe Telegraph and Trust, Limited, 4¾-5; Globe, 6 per cent. Preference, 10½-11½; Great Northern, 8½-8¾; Indo-European, Limited, 20-21; Mediterranean Extension, Limited, 2½-3; Mediterranean Extension, 8 per cent. Preference, 9-9½; Reuter's, Limited 9-10; Submarine, 220-230; Submarine Scrip, 2-2¼; West Coast of America, Limited, 1-1½; West India and Panama, Limited, 1½-1¾; Ditto, 6 per cent. First Preference 7½-8¼; Ditto, ditto, Second Preference, 7½-7¾; Western and Brazilian, Limited, 3¼-3½; Ditto, 6 per cent. Debentures "A," 95-99, Ditto, ditto, ditto, "B," 88-93; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 112-116; Ditto, 6 per cent. Sterling Bonds, 103-105; Telegraph Construction and Maintenance, Limited, 31-31½; Ditto, 6 per cent. Bonds, 108-111; Ditto, Second Bonus Trust Certificates, 2¼-2½; India Rubber Co., 12¼-12¾; Ditto, 6 per cent. Debenture, 105-108.